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ABSTRACT

This lesson plan is intended for use in conducting classes on plant tissues. Presented first are an attention step and a series of questions and answers designed to convey general information about plant tissues and the effect of water and minerals on them. The following topics are among those discussed: reasons why water is important to plants, the importance of proper and thorough watering to plant growth, conductive tissue in plants, plant components involved in transporting nutrients (minerals) and water, systemic pesticides, osmosis, active transport of plant nutrients, and transpiration. Also provided are the following: a glossary of pertinent scientific terms, four worksheets, answers to the worksheets, a quiz and quiz answers, five overhead transparency masters, and a lesson plan for helping students understand the function of xylem tissue in celery and flowers. Included in the lesson plan are an objective, list of equipment needed, and detailed steps for completing the activity. (MN)

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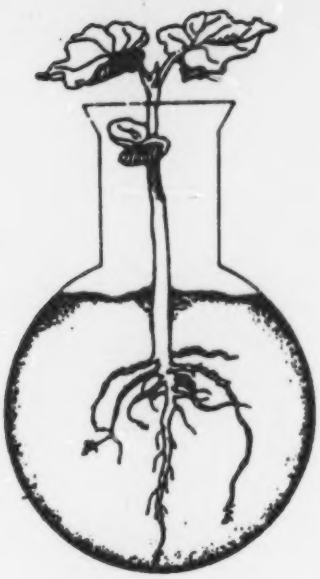

Agricultural Lesson Plans

PLANT TISSUES

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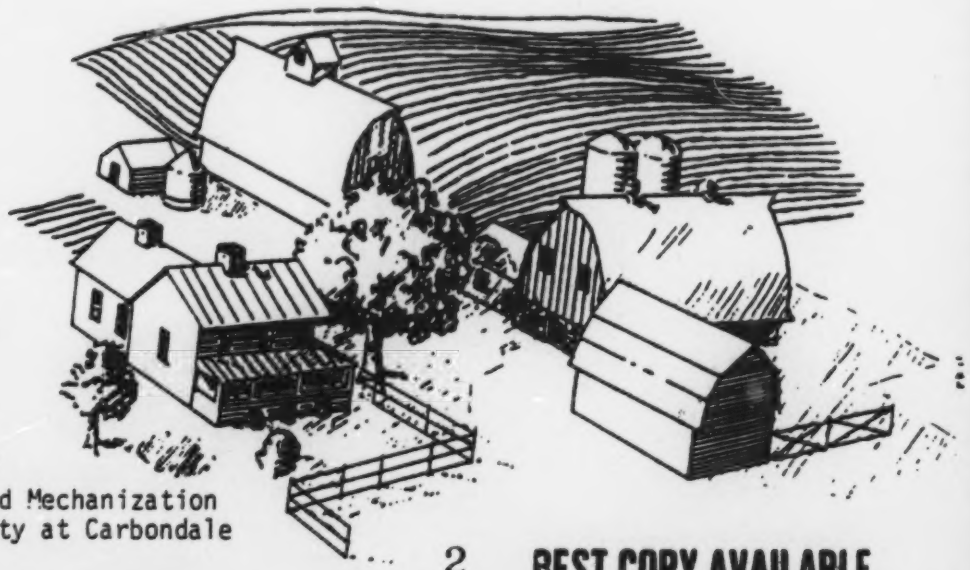

CF 065 310

Department of
Agricultural Education and Mechanization
Southern Illinois University at Carbondale

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Attention step.
Many cooks know that a limp piece of celery can be made stiff by placing it in a dish of water for 20 minutes or so. Why does this happen?

Water moves by osmosis into the celery. It moves from an area that is crowded with water (the dish of water) to an area where the water is less crowded (the limp celery).

1. What are seven reasons why water is important to plants.:

    1. The protoplasm in plant cells is generally made up of at least 90% water.
    2. Most chemical reactions in the protoplasm takes place in water.
    3. Water is a necessary ingredient in photosynthesis.
    4. Mineral salts must be dissolved in water before they can enter a plant.
    5. Materials must be dissolved in water in order to move throughout the plant by diffusion through cell membranes.
    6. Water exerts pressure against the cell walls to keep the plant rigid, instead of limp.
    7. Water also helps regulate the plants temperature.

2. When should plants be watered?
    Water plants when the soil feels dry to touch.

3. Why is it important to water ONLY at the proper time ?
    Plants that are grown for a hobby are often watered too much or too little. There must be air in the soil for plants to take up water. If the soil is continually full of water, then there is no room between individual soil particles for air. If plants get too dry between waterings, their growth will be reduced because the plant's ability to carry on photosynthesis is limited. If the plants are kept dry for too long, the result will be wilted and/or dead plants.

4. Why should plants be watered **thoroughly ?**.
    If you are watering a potted plant, make sure some of the water drains out of the drainage hole on the bottom of the pot. However, make sure you don't allow the plant to stand in water for more than a few minutes. If you are watering

plants growing in the ground, apply enough water so the plants will not have to be watered for another week. Watering thoroughly is necessary to prevent the buildup of salts in the soil.

5. Why should water be applied gently to the soil ?
   This will help prevent soil compaction and the spread of diseases from one plant to another. If you are watering plants with a hose, attach a water breaker or sprinkler to the end of the hose. You may also apply water by watering pots from underneath, using a wick, or using a drip irrigation system.

6. Why should you Avoid getting water on the foliage of the plant?
   Water can spot the foliage of some plants and can encourage the growth of foliar diseases.

7. Why Water early in the day ?
   By watering early in the day your plants will be dry be nightfall. This will reduce the chances of plant disease.

Plant's Conductive Tissue

8. What is the definition of a vascular plant ?
   Any plant containing xylem and phloem are called vascular plants.

9. What is the function of Xylem ?
   Xylem is the conductive tissue in a plant that carries water up the stem from the roots to the leaves.

10. What is the function of Phloem ?
    Phloem is the conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.

11. How do plants use parts in active transport of nutrients ?
    All vascular plants have true roots, stems, and leaves. Each plant part has specific functions. In order for the plant to survive and grow, all plant parts must have access to food and water. Plants depend on their own unique transportation network, xylem and phloem, to transport food and water throughout the plant.

12. What is a plants network for food & water ?
    Vascular plants have tissues made of tube-like cells that carry food and water throughout the plant. These tissues are called xylem and phloem. Xylem and phloem make up a plants transportation network for food and water.

13. How are minerals and water transported in plants ?
    Water and minerals can move from the roots of a plant up through the stem and leaves through the continuous xylem

system. Phloem also forms a continuous system, allowing food to move from plant leaves down through the stem to the root.

13. How does xylem transport nutrients ?
Xylem tissue transports a watery mixture called sap in a basically upward direction inside a plant. Sap generally contains water, minerals from the soil and sugars which have been stored in a plants' roots and stem. Xylem cells form the tubes that are used to transport sap. The xylem tubes are hollow and have thick walls. They help support the plant stem. In fact, xylem is the major part of woody stems. The wood that is used as lumber once was the xylem of a tree.

14. What is a systemic pesticide ?
Farmers and other plant growers also use xylem to transport systemic pesticide throughout plants. A pesticide is a material used to kill or repel pests. When a systemic pesticide is sprayed on a plant or applied to the soil, the plant absorbs the pesticide. The systemic pesticide travels to the xylem tissue. Once the systemic pesticide is in the sap in the xylem tissue it travels throughout the entire plant. The pesticide is then present in all plant parts.

15. How does Phloem move nutrients ?
Phloem tissue transports the food that is manufactured in plant leaves in a mainly downward direction inside a plant. The food which is dissolved in water is transported though the phloem tubes to the plant part needing the food (roots, stems, etc.) or to the plant part where it will be stored. The phloem tubes are not hollow and have very thin walls. Scientists do not fully understand the processes involved in the transporting of food through the phloem tissue.

16. **Where does Soil Water Enter plants ?**
Soil water enters a plant through the root hairs of a plant. Soil water is the water in the soil that contains some of the soil's dissolved minerals. Root hairs are hairlike structures on roots that absorb water and plant nutrients. The way soil water enters a plant involves several scientific principles. Once inside the root hairs, it moves into the xylem tissue. From there, the soil water can travel to the stem and leaves of a plant.

17. **How does Osmosis help plant nutrient transport ?**
Water enters the root hairs of a plant by osmosis. Osmosis is the diffusion of water though a cell membrane. The cell membrane is the thin living membrane surrounding the protoplasm of a cell. Water enters and leaves plant cells by osmosis. The cell membrane is selectively permeable. This means it only allows selected materials to pass through. The cell membrane lets water molecules pass in and out of the plant cells, but does not let many large molecules pass though it. Molecules are the smallest

particles of any substance that can exist independently. When the soil around a plant is watered, there are more water molecules in the soil than in the cells of the roots. Because of this, water moves from the soil (area where water molecules are more crowded) into the plant cells (area where water molecules are less crowded).

18. How can a cucumber be used to demonstrate osmosis ?
Cucumber slices are sometimes soaked in a salt water solution prior to pickling. A solution is a liquid that contains a dissolved substance. This is an example of osmosis. When the cucumber slices are soaked in salt water, the cucumber slices become limp. There are fewer water molecules in the salt water than in the plant cells. Using osmosis, water molecules travel from the plant cells to the salt water.

19. What happens when water enters a cell ?
Once water enters the plant cells, the cells begin to swell. The cell membrane will not let too much water into a cell. The wall of the plant cell prevents the cell from stretching and letting in too much water. Once enough water has entered a plant cell, it becomes stiff. This is the reason, most healthy plants have stems that are stiff and a wilted plant is limp.

20. How do plants use Active Transport ?
Plant cells use active transport to bring minerals from the soil water into the root hairs of the plant root. Active transport requires the plant cell to use energy to move materials in or out of the cell. Unlike diffusion, active transport moves material through the cell membrane even when the molecules of the material are in an area that are not crowded and are moving to an area where it is move crowded.

21. How are soil minerals forced into root hairs ?
The concentration of minerals in the soil that are available for plant use is usually less than the concentration of minerals in the root hairs. The minerals in the soil must be dissolved in the soil water in order to be available to the plant. The minerals in soil water are able to enter the plant cell even though they are moving from an area where molecules are less crowded to an area where molecules are more crowded. Root cells use energy to force minerals from the soil water into the root hairs.

22. How does Water leave a plant ?
Transpiration accounts for the majority of water leaving a plant. The evaporation of water from the above ground surface of the plant is called transpiration. The transpiration rate is highest when the air is dry and/or windy. The rate of transpiration is slowed when the stomata is closed.

23. How does transpiration work ?

When transpiration from the leaves occurs, the amount of water molecules in the leaves is reduced. as a result, water travels from the xylem cells in the leaves to other leaf cells by osmosis. The xylem cells in the leaves then actually pull the water up the xylem tissue. The water molecules in the xylem stick together and form a column of water that reaches from the plant's leaves down to the roots. So when transpiration occurs, each water molecule in the water column pulls on the next one. As the column of water moves upward, it pulls soil water into the roots. Consequently, water is pulled up through the stems of a plant by the pull transpiration has on the water column in the xylem tissue.

GLOSSARY OF SCIENTIFIC TERMS:

Active Transport -	The movement of molecules with the use of outside energy from a less to a more crowded area.
Cell Membrane -	Thin living membrane surrounding the protoplasm of a cell.
Cell Wall -	The rigid covering of a plant cell.
Diffusion -	The movement of molecules from where they are crowded to where they are less crowded.
Mineral Salts -	Minerals that are dissolved in the water in the soil.
Molecule -	The smallest particles of any substance that can exist independently.
Osmosis -	The diffusion of water through a selectively permeable membrane, such as a cell membrane.
Pesticide -	Material used to kill or repel pests.
Phloem -	The conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.
Photosynthesis -	Process in which green plants convert water and carbon dioxide in the presence of light into sugar

	with oxygen being released into the atmosphere as a by product.
Protoplasm -	The essential living matter of all plant and animal cells.
Root Hairs -	Hairlike structures on roots that absorb water and plant nutrients (elements).
Sap -	Water mixture inside plants that contains water, minerals from the soil, and sugar which have been stored in plant roots.
Selectively Permeable -	Allows only selected materials to pass through.
Soil Water -	Water in the soil that contains some of the soil's dissolved minerals.
Solution -	Liquid that contains a dissolved substance.
Transpiration -	The evaporation of water from the above ground surface of plants.
Xylem -	The conductive tissue in a plant that carries water up the stem from the roots to the leaves.

WORK SHEET A

Directions: Complete the following questions.

A. Fill-in-the-blank:

1. The protoplasm in plant cells is generally made up of at least _____ water.

2. Mineral salts must be dissolved in _____ before they can enter a plant.

3. Materials must be dissolved in _____ in order to move throughout the plant by diffusion through cell membranes.

4. Water exerts pressure against the _____ to keep the plant rigid, instead of limp.

5. Plants can be watered when the _____ feels dry to touch.

B. Short Answer:

6. Why should plants be watered thoroughly when watered?

7. How can water be gently applied to the soil around a plant?

WORK SHEET B

Directions:

The answers to the following fill-in-the-blank questions are terms which have something to do with Plant Conductive Tissues. Choose the terms from the word list below that best answers each question.

Word List:

Active Transport
Cell Membrane
Cell Wall
Diffusion
Mineral Salts
Molecules
Osmosis
Pesticide
Phloem
Photosynthesis
Protoplasm
Root Hairs
Sap
Selectively Permeable
Soil Water
Solution
Transpiration
Xylem

Fill-in-the-blank:

1. The essential living matter of all plant and animal cells is _____.

2. The _____ is the living membrane surrounding the protoplasm of a cell.

3. The _____ is the rigid covering of a plant cell.

4. _____ is the conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.

5. _____ is the conductive tissue in a plant that carries water up the stem from the roots to the leaves.

6. The process in which green plants convert water and carbon dioxide in the presence of light into sugar is called _____.

7. _____ are the smallest particles of any substance that can exist independently.

8. The hairlike structure on roots that absorb water and plant nutrients are _____.

9. When a membrane is _____, it only allows selected material to pass through.

10. The movement of molecules from where they are crowded to where they are less crowded is _____.

11. _____ is the movement of molecules with the use of outside energy, from a less to a more crowded area.

12. The diffusion of water through a selectively permeable membrane, such as a cell membrane, is _____.

13. _____ is the evaporation of water from the above ground surface of plants.

14. A _____ is a liquid that contains a dissolved substance.

15. The water in the soil that contains some of the soil's dissolved minerals is _____.

16. The watery mixture inside a plant that contains water, minerals from the soil, and sugars which have been stored in plant roots is called _____.

17. _____ are the minerals that are dissolved in the water in the soil.

18. A _____ is a material used to kill or repel pests.

WORK SHEET C

Directions: Complete the following questions.
&
A. Fill-in-the-blank:

1. All vascular plants have true roots, _____, and _____.

2. All parts of a plant must have access to _____ and _____ to survive and grow.

3. Xylem and phloem make up a plant's transportation network for _____ and _____.

4. Water and minerals can move from the roots of a plant up through the stem and leaves through the continuous _____ system.

5. Food can move from plant leaves down through the stem to the roots through the continuous _____ system.

6. Xylem transports sap in a basically _____ direction.

7. Xylem _____ are hollow and have thick walls.

8. Phloem tissue transport the food that is manufactured in plant leaves in a mainly _____ direction inside a plant.

9. The phloem tubes of a plant have very _____ walls.

10. Soil water enters a plant through the _____ of a plant.

11. Water enters the root hairs of a plant by _____.

12. When the soil around a plant is watered, there are _____ water molecules in the soil than in the cells of the roots.

13. The _____ of the plant cell prevents the cell from stretching and letting in too much water during osmosis.

14. Plant cells use _____ to bring minerals from the soil water into the root hairs of the plant root.

15. The concentration of minerals in the soil that is available for plant use is usually _____ than the concentration of minerals in the root hairs.

16. Root cells use _____ to force minerals from the soil water into the root hairs.

17. _____ accounts for the majority of water that leaves a plant.

18. The transpiration rate is highest when the air is _____.

19. During transpiration, the xylem cells in the leaves pull the _____ up the xylem tissue.

20. Water is pulled up through the stems of a plant by the pull transpiration has on the _____ in the xylem tissue.

WORK SHEET A

Directions: Complete the following questions.

A. Fill-in-the-blank:

1. The protoplasm in plant cells is generally made up of at least *90%* water.

2. Mineral salts must be dissolved in *water* before they can enter a plant.

3. Materials must be dissolved in *water* in order to move throughout the plant by diffusion through cell membranes.

4. Water exerts pressure against the *cell walls* to keep the plant rigid, instead of limp.

5. Plants can be watered when the *soil* feels dry to touch.

B. Short Answer:

6. Why should plants be watered thoroughly when watered?

   Plants should be watered thoroughly to prevent the build up of salts in the soil.

7. How can water be gently applied to the soil around a plant?

   If using a hose, attach a breaker or sprinkler to the end of the hose. Slow drip automatic watering devises are used in the commercial growing of plants. If watering a potted plant, you may also water from the bottom or use a wick.

WORK SHEET B

Directions:

The answers to the following fill-in-the-blank questions are terms which have something to do with Plant Conductive Tissues. Choose the terms from the word list below that best answers each question.

Word List:

Active Transport
Cell Membrane
Cell Wall
Diffusion
Mineral Salts
Molecules
Osmosis
Pesticide
Phloem
Photosynthesis
Protoplasm
Root Hairs
Sap
Selectively Permeable
Soil Water
Solution
Transpiration
Xylem

Fill-in-the-blank:

1. The essential living matter of all plant and animal cells is ***protoplasm.***

2. The ***cell membrane*** is the living membrane surrounding the protoplasm of a cell.

3. The ***cell wall*** is the rigid covering of a plant cell.

4. ***Phloem*** is the conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.

5. ***Xylem*** is the conductive tissue in a plant that carries water up the stem from the roots to the leaves.

6. The process in which green plants convert water and carbon dioxide in the presence of light into sugar is called ***photosynthesis***.

7. *Molecules* are the smallest particles of any substance that can exist independently.

8. The hairlike structure on roots that absorb water and plant nutrients are *root hairs*.

9. When a membrane is *selectively permeable*, it only allows selected material to pass through.

10. The movement of molecules from where they are crowded to where they are less crowded is *diffusion*.

11. *Active Transport* is the movement of molecules with the use of outside energy, from a less to a more crowded area.

12. The diffusion of water through a selectively permeable membrane, such as a cell membrane, is *osmosis*.

13. *Transpiration* is the evaporation of water from the above ground surface of plants.

14. A *solution* is a liquid that contains a dissolved substance.

15. The water in the soil that contains some of the soil's dissolved minerals is *soil water*.

16. The watery mixture inside a plant that contains water, minerals from the soil, and sugars which have been stored in plant roots is called *sap*.

17. *Mineral salts* are the minerals that are dissolved in the water in the soil.

18. A *pesticide* is a material used to kill or repel pests.

STUDENT ACTIVITY SHEET

Xylem Tissue in Celery and Flowers

a. **Purpose:** Prove water does move up plant stems and observe the xylem tissue in plants.

b. **What Each Student Needs:**

cup	food coloring (red or blue)
spoon	waterproof marker
water	knife or scalpel
celery stalk with leaves	or a white flower

c. **Here's How:**

1. Write your name with the waterproof marker on the cup.
2. Put 1/2 cup (120 ml) of water into the cup.
3. Add 10 drops of food coloring to the water.
4. Stir food coloring into the water.
5. Cut one inch off the bottom of the stalk of celery or stem of the white flower with a scalpel or sharp knife. CAUTION: Be careful when handling the knife or scalpel. The blades are sharp, so point the blade away from you.
6. Put the stalk of celery or white flower upright in the cup of food coloring solution.
7. Let the celery or white flower stand upright in the food coloring solution for at least 24 hours.

8. Answer the following questions on the first day of the activity, after you have put the stalk of celery or white flower in the food coloring solution.

What will happen to the leaves on the celery stalk or white flower in the next 24 hours?
They will turn the color of the food coloring solution.

What will happen to the flower stem or stalk of celery?
The xylem tissue will be dyed the color of the food coloring solution.

3. What is the function of xylem?
The function of xylem is to transport water and minerals up the stem of the plant to the leaves.

4. What is the function of phloem?
The function of phloem is to transport food from the leaves to the roots and other plant parts.

9. After 24 hours, remove the celery or white flower from the food coloring solution.

10. Examine the cut end of the celery or white flower.

11. Examine the celery leaves or the flower and leaves of the white flower.

12. Cut the stem or stalk in half crosswise and lengthwise to observe the stem or stalk.

13. Answer the following questions after you have taken the stalk of celery or white flower from the food coloring solution.

1. What happened to the leaves and/or flowers during this activity?
They were dyed the color of the food coloring solution.

2. What happened to the flower stem or celery stalk?
The xylem tissue was dyed the color of the food coloring solution.

3. What stem tissue has been dyed? How was it dyed?
The xylem tissue was dyed in this activity. The food coloring solution moved up the xylem tissue as water was transported to the leaves and flower of the celery and/or white flower.

4. What did the stem tissue look like when you cut a cross-section of it? (You may draw a diagram.)
Answers will vary.

5. What plant tissue transports water?
The xylem tissue transports water from the roots of a plant to the leaves of a plant.

WORK SHEET C

Directions: Complete the following questions.

A. Fill-in-the-blank:

1. All vascular plants have true roots, *stems*, and *leaves*.

2. All parts of a plant must have access to *food* and *water* to survive and grow.

3. Xylem and phloem make up a plant's transportation network for *food* and *water*.

4. Water and minerals can move from the roots of a plant up through the stem and leaves through the continuous *xylem* system.

5. Food can move from plant leaves down through the stem to the roots through the continuous *phloem* system.

6. Xylem transports sap in a basically *upward* direction.

7. Xylem *tubes* are hollow and have thick walls.

8. Phloem tissue transport the food that is manufactured in plant leaves in a mainly *downward* direction inside a plant.

9. The phloem tubes of a plant have very *thin* walls.

10. Soil water enters a plant through the *root hairs* of a plant.

11. Water enters the root hairs of a plant by _osmosis_.

12. When the soil around a plant is watered, there are _more_ water molecules in the soil than in the cells of the roots.

13. The _cell wall_ of the plant cell prevents the cell from stretching and letting in too much water during osmosis.

14. Plant cells use _active transport_ to bring minerals from the soil water into the root hairs of the plant root.

15. The concentration of minerals in the soil that is available for plant use is usually _less_ than the concentration of minerals in the root hairs.

16. Root cells use _energy_ to force minerals from the soil water into the root hairs.

17. _Transpiration_ accounts for the majority of water that leaves a plant.

18. The transpiration rate is highest when the air is _dry or windy_.

19. During transpiration, the xylem cells in the leaves pull the _water_ up the xylem tissue.

20. Water is pulled up through the stems of a plant by the pull transpiration has on the _water column_ in the xylem tissue.

WORK SHEET D:STUDENT REVIEW Short Answer.

1. List seven reasons why water is important to plants.

2. What five things should you remember when watering plants?

3. What is the function of xylem?

4. List two characteristics of xylem.

5. What is the function of phloem?

6. List two characteristics of phloem.

7. Where does water enter a plant?

8. What is osmosis?

9. How do water molecules enter plant cells?

10. What is active transport?

11. How do mineral salts enter a plant cell?

WORK SHEET D: STUDENT REVIEW Short Answer.

1. List seven reasons why water is important to plants.
   The protoplasm in plant cells is made up of 90% water. Most chemical reactions in the protoplasm take place in water. Water is a necessary ingredient in photosynthesis. Mineral salts must be dissolved in water before they can enter a plant. Materials must be dissolved in water to move throughout the plant. Water keeps the plant rigid, instead of limp. Water helps regulate the plant's temperature.

2. What five things should you remember when watering plants?
   Water plants when the soil feels dry to touch. When watering, water thoroughly. Apply the water gently to the soil. Avoid getting water on the foliage. Water early in the day.

3. What is the function of xylem?
   Xylem transports water, minerals from the soil, and stored food from the roots to the leaves of a plant.

4. List two characteristics of xylem.
   Xylem transports water in an upward direction. Xylem cells form hollow tubes that have thick walls. Xylem helps support the plant stem.

5. What is the function of phloem?
   Phloem transports the food that is manufactured in plant leaves to other plant parts.

6. List two characteristics of phloem.

   Phloem transports food in a downward direction. The phloem tubes are not hollow and have very thin walls.

7. Where does water enter a plant?
   Water enters a plant through the root hairs on the root.

8. What is osmosis?
   Osmosis is the diffusion of water through a cell membrane.

9. How do water molecules enter plant cells?
   Water molecules enter the plant cells by osmosis.

10. What is active transport?
    Active transport is the movement of molecules with the use of outside energy from a less to a more crowded area.

11. How do mineral salts enter a plant cell?
    Mineral salts enter plant cells by active transport.

QUIZ

A. Matching:

Match the best definition with each term:

_____1.	Osmosis	a.	Thin living membrane surrounding the protoplasm of a cell.
_____2.	Active Transport	b.	The rigid covering of a plant cell.
_____3.	Transpiration	c.	The evaporation of water from the above ground surface of plants.
_____4.	Xylem	d.	The diffusion of water through a selectively permeable membrane, such as a cell membrane.
_____5.	Phloem	e.	The conductive tissue in a plant that carries water up the stem from the roots to the leaves.
_____6.	Cell Membrane	f.	The movement of molecules with the use of outside energy from a less to a more crowded area.
_____7.	Cell Wall	g.	The conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.

B. True or False:

_____8. Xylem and phloem form a continuous transportation network throughout the plant.

_____9. Water molecules move into a plant by active transport.

_____10. The concentration of minerals in the soil that is available for plant use is usually less than the concentration of minerals in the root hairs.

_____11. Materials must be dissolved in water in order to move throughout the plant by diffusion through cell membranes.

_____12. Water is pulled up through the stems of a plant by the pull transpiration has on the water column in the xylem tissue.

C. Fill-in-the-blank:

13. Soil water enters a plant through the _____ of a plant.

14. The _____ prevents the plant cell from stretching and letting too much water into a cell.

15. _____ tissue transports sap in a basically upward direction.

16. _____ tubes have very thin walls and are not hollow.

D. Short Answer:

17. Explain how a plant should be watered.

ANSWERS TO QUIZ

A. Matching:

Match the best definition with each term:

d 1.	Osmosis	a.	Thin living membrane surrounding the protoplasm of a cell.
f 2.	Active Transport	b.	The rigid covering of a plant cell.
c 3.	Transpiration	c.	The evaporation of water from the above ground surface of plants.
e 4.	Xylem	d.	The diffusion of water through a selectively permeable membrane, such as a cell membrane.
g 5.	Phloem	e.	The conductive tissue in a plant that carries water up the stem from the roots to the leaves.
a 6.	Cell Membrane	f.	The movement of molecules with the use of outside energy from a less to a more crowded area.
b 7.	Cell Wall	g.	The conductive tissue in plants that carries sugars and minerals from the leaves to other parts of a plant.

B. True or False:

True 8. Xylem and phloem form a continuous transportation network throughout the plant.

False 9. Water molecules move into a plant by active transport.

True 10. The concentration of minerals in the soil that is available for plant use is usually less than the concentration of minerals in the root hairs.

True 11. Materials must be dissolved in water in order to move throughout the plant by diffusion through cell membranes.

True 12. Water is pulled up through the stems of a plant by the pull transpiration has on the water column in the xylem tissue.

C. Fill-in-the-blank:

13. Soil water enters a plant through the *root hairs* of a plant.

14. The *cell wall* prevents the plant cell from stretching and letting too much water into a cell.

15. *Xylem* tissue transports sap in a basically upward direction.

16. *Phloem* tubes have very thin walls and are not hollow.

D. Short Answer:

17. Explain how a plant should be watered.

Water a plant when the soil feels dry to touch. Water plants thoroughly. Apply water gently to the soil. Avoid getting water on the foliage. Water early in the day.

OH1

IMPORTANCE OF WATER TO PLANTS

WATER:

1. Makes up 90% of a plant.
2. Where most chemical reactions occur.
3. Needed for photosynthesis.
4. Carries mineral salts into the plant.
5. Carries dissolved materials throughout plant.
6. Keeps plant rigid.
7. Regulates plant temperature.

OH2

WATERING PLANTS

Water Plants:

1. When soil feels dry.

2. Thoroughly.

3. Gently.

4. Without getting water on foliage.

5. Early in the day.

OH3

XYLEM:

1. Transports sap.

2. Transports in an upward direction.

3. Cells form hollow tubes that have thick walls.

4. Helps support the plant stem.

OH4

PHLOEM:

1. Transports food.

2. Transports in a downward direction.

3. Cells form tubes that have thin walls and are not hollow.

OH5

OSMOSIS:

1. Is the method water moves into a plant and from cell to cell within a plant.

2. Is the diffusion of water through a selectively permeable membrane (Cell membrane).

3. Molecules move from a crowded area to a less crowded area.